

# The Stored-program Computer

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- **Program:**

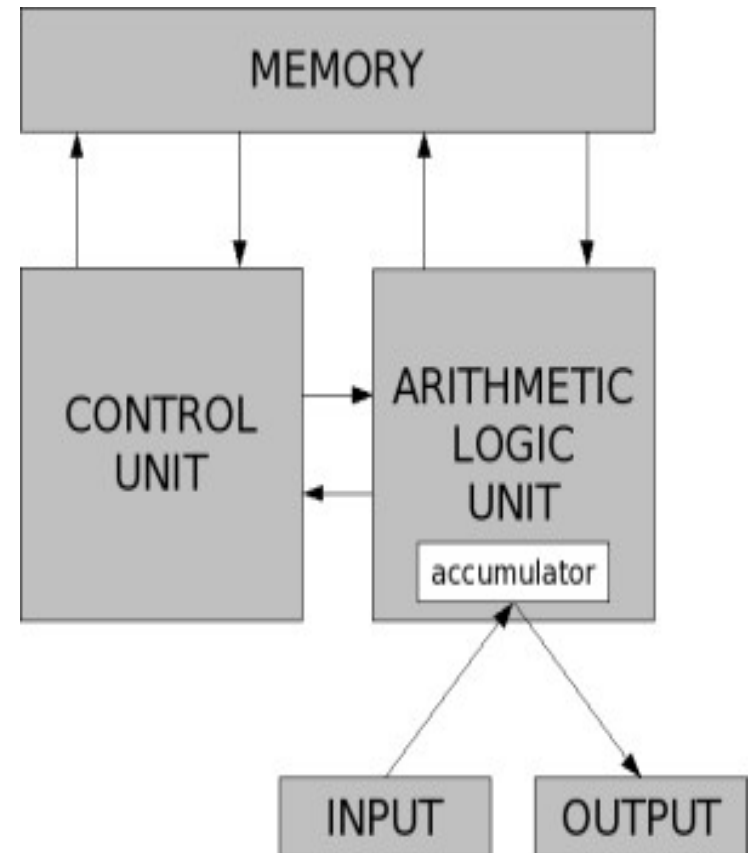
- A collection of instructions for the computer to perform one by one.

- **Machine Language:**

- The language of the computing machine.
  - All instructions must be in the form of binary numbers (binary code).

# The Stored-program Computer

- **Stored-program Computer:**
  - Also known as the von Neumann-type computer.
  - Has memory - a place to keep both:
    - instructions (ie program)
    - and the needed information (ie data)
  - needed for computation by the computer.
- Separation of storage from the processing unit is implicit in the von Neumann architecture.
- [http://en.wikipedia.org/wiki/Von\\_Neumann\\_architecture](http://en.wikipedia.org/wiki/Von_Neumann_architecture)

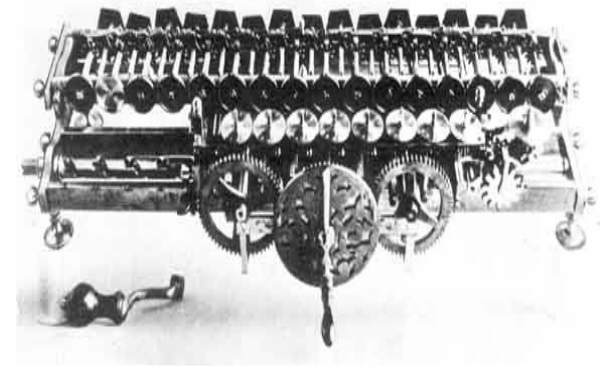


- **How is each conceptual computer similar?**
  - Each is a **stored-program computer** (von Neumann computer)
    - Each contains a minimal configuration of:
      - Input units
      - Memory
      - Central processing unit
      - Output units
  - Each stores a program and the data it needs in its own memory.
  - Each executes instructions sequentially.
  - Each is designed with very limited capabilities. (small memory and instruction set.)

# Leibniz

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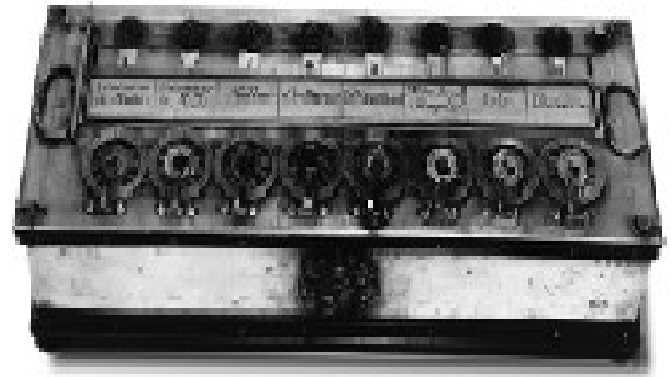
- German Philosopher 1646-1716
- Step Reckoner (1671)  
add, subtract, multiply, divide  
evaluate square roots
- he invented it in his sleep
- The Calculus Ratiocinator is a  
concept appearing in the writings  
of Gottfried Leibniz, usually paired  
with his characteristica  
universalis, which he mentioned  
much more frequently.



## Schickard & Pascal

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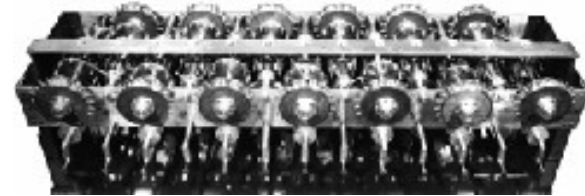
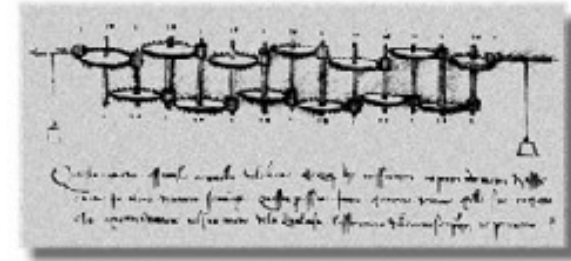
- **Schickard 1625:**  
adds, subtracts, multiplies, divides
- **Blaise Pascal 1640:**  
Arithmetic Machine: only add and subtract
- **50 pieces made**



# Leonardo da Vinci (1452-1519)

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- Many references cite the French mathematician, physicist, and theologian, **Blaise Pascal** as being credited with the invention of the first operational calculating machine called the Arithmetic Machine.
- It now appears that the first mechanical calculator may have been conceived by Leonardo da Vinci almost 150 years earlier than Pascal's machine
- Calculator figures
  - Sketch of Calculator:
  - Working model based on sketch



# 1946

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- In February, the public got its first glimpse of the **ENIAC**, a machine built by John Mauchly and J. Presper Eckert that improved by 1,000 times on the speed of its contemporaries.

START OF PROJECT: 1943

COMPLETED: 1946

PROGRAMMED: plug board and switches

SPEED: 5,000 operations per second

INPUT/OUTPUT: cards, lights, switches, plugs

FLOOR SPACE: 1,000 square feet

PROJECT LEADERS: John Mauchly and J. Presper Eckert.

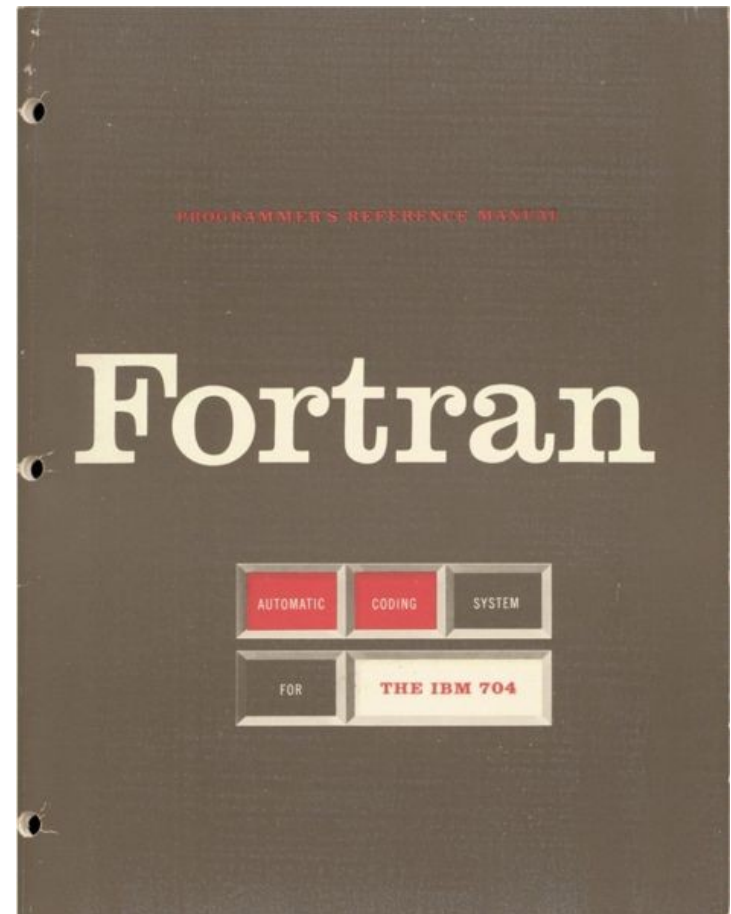
# 1957...

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- A new language, **FORTRAN** (short for formula translator), enabled a computer to perform a repetitive task from a single set of instructions by using loops.

The first commercial FORTRAN program ran at Westinghouse, producing a missing comma diagnostic.

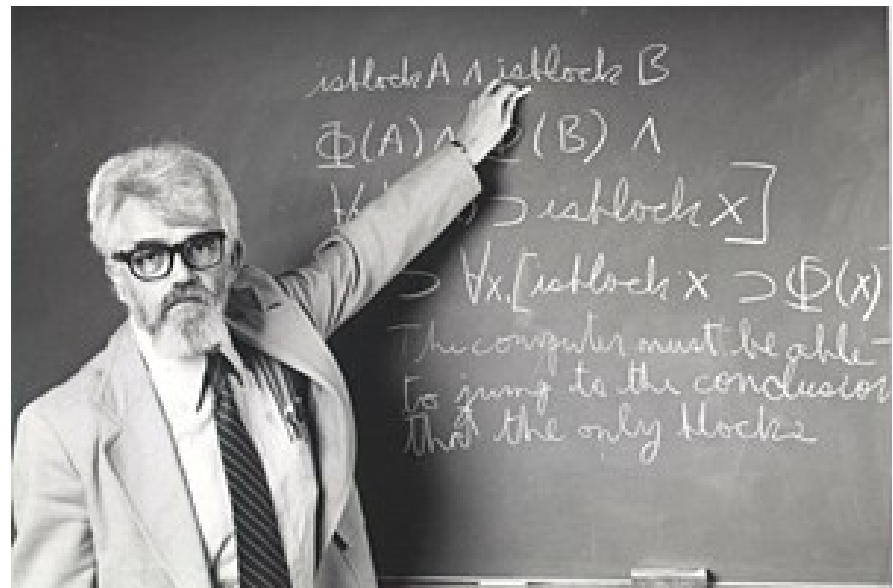
A successful attempt followed.





# 1960

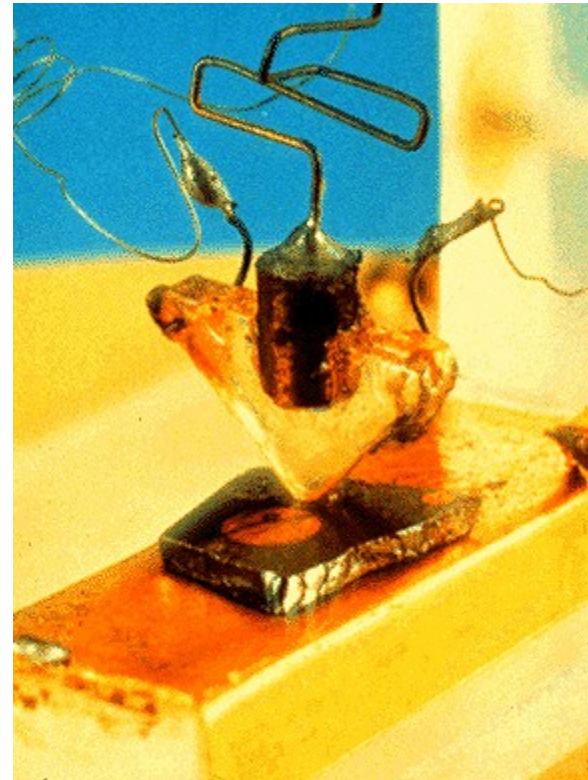
- A team drawn from several computer manufacturers and the Pentagon developed **COBOL**, Common Business Oriented Language. Project leader: Grace Hopper.
- **LISP** made its debut as the first computer language designed for writing artificial intelligence programs. Inventor: John McCarthy.



# 1947

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- Three scientists at **Bell Telephone Laboratories**, William Shockley, Walter Brattain, and John Bardeen demonstrate their new invention of the point-contact transistor amplifier.



## Early AI (Artificial Intelligence) programs: checkers, chess (in Britain)

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- Strachey wrote a **checkers program** for the Ferranti Mark I at Manchester (with Turing's encouragement and utilising the latter's recently completed **Programmers' Handbook** for the Ferranti computer). By the summer of 1952 this program could, Strachey reported, "play a complete game of Draughts at a reasonable speed".
- Prinz's **chess program**, also written for the Ferranti Mark I, first ran in November 1951. It was for solving simple problems of the mate-in-two variety. The program would examine every possible move until a solution was found. On average several thousand moves had to be examined in the course of solving a problem, and the program was considerably slower than a human player.
- Turing started to program his **Turochamp chess-player** on the Ferranti Mark I but never completed the task. Unlike Prinz's program, the Turochamp could play a complete game and operated not by exhaustive search but under the guidance of rule-of-thumb principles devised by Turing.

## Early AI programs: checkers (in USA)

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- The first AI program to run in the U.S. was also a checkers program, written in 1952 by **Arthur Samuel** of IBM for the IBM 701.
- Samuel took over the essentials of Strachey's program (which Strachey had publicised at a computing conference in Canada in 1952) and over a period of years considerably extended it.
- In 1955 he added features that enabled the program to learn from experience, and therefore improve its play. Samuel included mechanisms for both rote learning and generalisation. The program soon learned enough to outplay its creator. Successive enhancements eventually led to the program winning a game against a former Connecticut checkers champion in 1962 (who immediately turned the tables and beat the program in six games straight).

# 1976

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- **Steve Jobs and Steve Wozniak** form the **Apple Computer Company**, on April Fool's Day.
- The **Apple I computer board** is **sold in kit form**, and delivered to stores by Steve Jobs and Steve Wozniak. Price: US\$666.66.
- Paul Terrell orders **50 Apple computers** from Steve Jobs, for his Byte Shop.



## 1965 ...1968

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- **Douglas C. Engelbart**, of the Stanford Research Institute, demonstrates his **system of keyboard, keypad, mouse, and windows** at the Joint Computer Conference in San Francisco's Civic Center. He demonstrates use of **a word processor, a hypertext system, and remote collaborative work with colleagues**.
- Robert Noyce and Gordon Moore leave Fairchild Semiconductors.
- Robert Noyce and Gordon Moore found **Intel Corporation**.



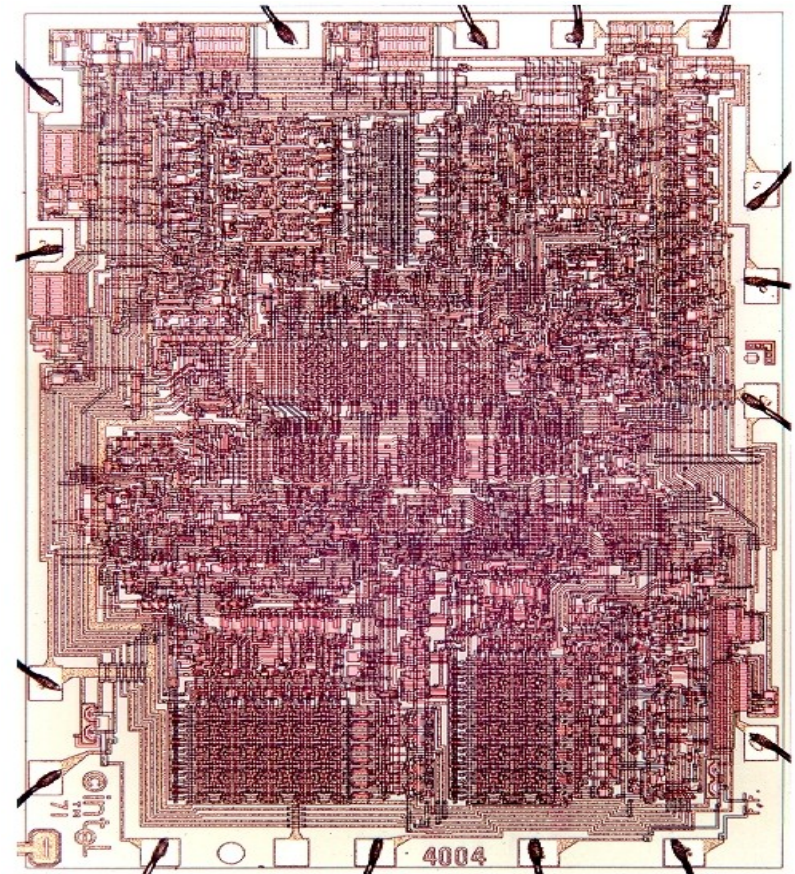
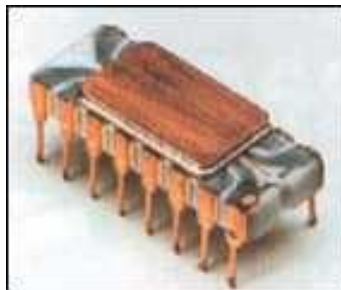
# First microprocessor: Intel 4004

**1969**

- The first microprocessor – CPU

**1971**

- The first commercial 4-bit microprocessor 4004:
- 2,300 transistors
- 10  $\mu\text{m}$  features
- 10 mm<sup>2</sup> die
- 108 kHz
- 60,000 operations in one second.



# 1984 main highlights

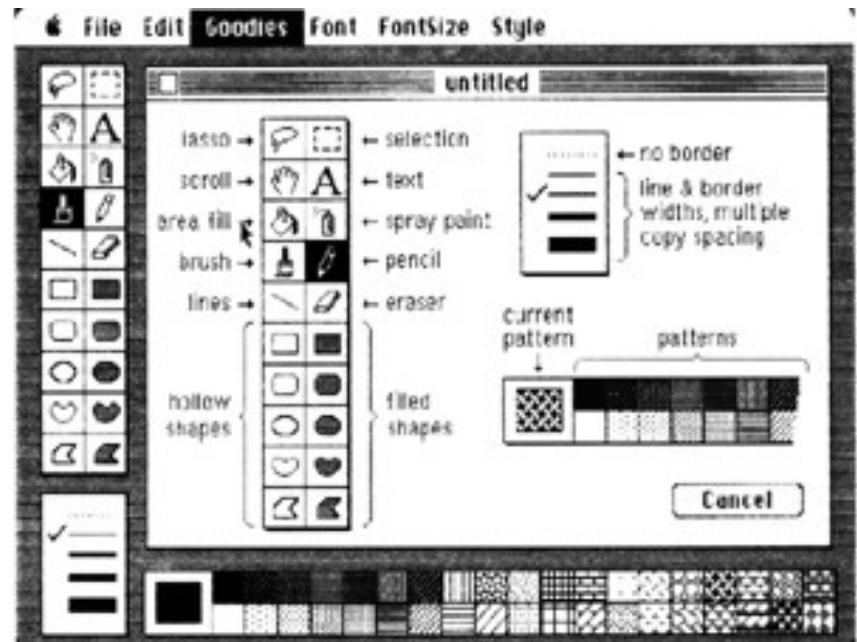
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- **Apple Computer launched the Macintosh**, the first successful mouse-driven computer with a graphic user interface, with a single \$1.5 million commercial during the 1984 Super Bowl.
- **The 3 1/2-inch "microfloppy" diskette** won widespread acceptance, aided by Apple Computer's decision to integrate its use into the new Macintosh.
- **IBM released its PC Jr. and PC-AT**. The PC Jr. failed, but the PC-AT, several times faster than original PC and based on the Intel 80286 chip, claimed success with its notable increases in performance and storage capacity, all for about \$4,000.
- In his novel "Neuromancer," William Gibson coined the term **"cyberspace."** He also spawned a genre of fiction known as "cyberpunk" in his book, which described a dark, complex future filled with intelligent machines, computer viruses, and paranoia.
- **GNU** project launched
- **X-Window** system started in MIT



# 1984: Apple Macintosh

- Apple Computer's Steve Jobs introduces the **Apple Macintosh** at the Flint Center of DeAnza College in Cupertino, California. The Macintosh uses the 8-MHz 32-bit Motorola 68000 CPU, built-in 9-inch B/W screen, 512x342 graphics, 400KB 3.5-inch floppy disk drive, mouse, 128KB RAM, and weighs 20 pounds. Price: US\$2500.



# 1995

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- **Be Inc.** introduces the BeBox
  - 1990 saw Jean Louis Gassée and Steve Sakoman leave their posts at Apple Computer **and start working towards their dream of creating a new kind of computer; one that would inspire both users and developers.** In late 1990, more Apple refugees, including Erich Ringewald and Bob Herold, joined Gassée and Sakoman at their as yet un-named company. ....
  - In January 1997, **Be announced that it was ceasing production of the BeBox, and would instead focus its efforts on further developing the BeOS. Roughly 1800 BeBoxen had been manufactured.**
- Borland International ships **Borland Delphi.**
- Sun Microsystems announces sample availability of the 64-bit UltraSPARC microprocessor.
- **IBM buys Lotus Development** for US\$3.5 billion in cash.
- **Sun** brings out the portable **Java language and associated libraries.** Java is initially used for writing small applets in HTML web pages, but after a while focus shifts to “ordinary programs” without browsers, especially on servers.

# 1990: HTML, http and the browser are born

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- **The World Wide Web was born** when **Tim Berners-Lee**, a researcher at CERN, the high-energy physics laboratory in Geneva, developed HyperText Markup Language.
- **HTML**, as it is commonly known, allowed the Internet to expand into the World Wide Web, using specifications he developed such as **URL** (uniform resource locator) and **HTTP** (hypertext transfer protocol).
- Berners-Lee based the World Wide Web on Enquire, a hypertext system he had developed for himself, with the aim of allowing people to work together by combining their knowledge in a global web of hypertext documents.
- With this idea in mind, Berners-Lee designed **both the first World Wide Web server and browser -- available to the general public in 1991.**

First web server address: [info.cern.ch](http://info.cern.ch)

- Berners-Lee founded the **W3 Consortium**, which coordinates World Wide Web development.  
**[www.w3c.org](http://www.w3c.org)**

